

2005 NE-SARE Annual Report

Project Number: LNE03-175 (USDA 2003-3860-12985)

Project Title: SOIL HEALTH ASSESSMENT, MANAGEMENT, AND TRAINING:
VEGETABLE PRODUCTION SYSTEMS

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Summary:

This project was initiated by our Soil Health Work Team (consisting of vegetable growers, cooperative extension staff and multidisciplinary faculty) in order to address the progressive deterioration of vegetable soils and to develop appropriate management solutions. During the project, the soil health status of 50 to 100 vegetable farms throughout the production areas in New York will be determined. Project impact on the awareness and knowledge of soil health issues and production practices of 100 to 250 growers will be monitored through mailed surveys, interviews and participatory activities. Demonstration trials on various soil management practices will be conducted in 5 commercial production regions and also on established long-term soil health sites. The established trials (including modification in crop rotations, cover crops, soil amendments, tillage systems, pest control, transition to organic production and others) will be intensively monitored for biological, chemical and physical soil quality indicators as well as impact on farm profitability. The project will also develop and field-test various new measurements to be included in a soil health assessment protocol; a demonstration kit for educators, a website; and a package of outreach materials for soil health assessment and management.

Objectives/ Performance Targets:

Fifty growers will implement two or more promoted management practices to improve soil quality and health on their farms. The latter may include: using new soil health tests to determine appropriate management practices; incorporating a new main and/or cover crop into their rotation scheme, changing tillage practices employed, using a new compost or other soil amendments, and adopting sustainable pest management practices, including IPM strategies.

A “soil health assessment protocol” will be developed and field-tested to the stage where it is ready to be institutionalized (i.e., become a permanent feature of fee services) offered by Cornell University and/or commercial soil testing laboratories.

2005 Accomplishments Made Towards Milestones:

- **Assessment of Current Soil Health Knowledge (Milestone 1):** Accomplished and documented in previously.
- **Outreach and Extension Efforts (Milestone 2):** With the continued expansion of our outreach and extension activities in New York, we have been able to reach more than 500 growers, extension educators and consultants in 2005. The team was involved with more than 10 field meetings and has given over 20 invited presentations. In 2005, we had a full day session on soil health at the Empire Fruit & Vegetable Expo which took place in Syracuse, NY. Approximately 150 growers and extension educators attended this session which laid the foundation for a hands-on workshop which took place in Ithaca, NY in March 2005. This workshop of about 30 participants including many crop consultants focused on the interactive demonstration and participatory discussion of various biological and physical soil health measurement tools. The training of these crop consultants will facilitate the continued dissemination of soil health information since they are actively engaged with growers throughout the state. The feedback from these various meetings and presentations has been very positive. We are planning a more comprehensive hands-on training for 2006, which will involve the demonstration of improved soil health management practices using the Gates Farm Long-Term Soil Health site in Geneva.

- **Assessment of the Soil Health Status of 50 to 100 Vegetable Farms (Milestone 3):** With the help of our extension educators, our soil sampling efforts expanded in 2005 to include 15 new grower sites ranging from Erie and Niagara Counties eastward to Greene County and into Northern New York. Some of these growers are interested in assessing the soil health status of newly acquired fields while others are interested in determining how specific management practices are impacting the health of their soils. For example, one grower in Western New York is interested to know if a 1½ year alfalfa rotation is enough or if a longer rotation would be more beneficial. The continued collection and analysis of such soil samples will broaden the data set and provide a more representative soil health assessment of New York fields. To-date, soil samples have been collected from over 60 fields on 25 farms. The minimum set of soil health indicators established in 2005 (described below) has increased the soil sampling processing efficacy and will enable us to sample more farms in spring 2006. The information learned from the analysis of these fields has helped to better describe the limits of soil health status of New York State soils.
- **Long-term Soil Health Sites, Grower Demonstration Sites, and the Effect of Management Practices on Soil Quality (Milestone 4):** We have continued to maintain our established grower-managed demonstration and our long-term research soil health sites. These sites have served and continue to serve as important venues for soil health field days. For example in August 2005, during a soil health field day with growers in central and western New York, a total of 30 growers and other participants were able to visit three grower demonstration sites and our long-term soil health site at Gates Farm in Geneva, NY. The grower at each site led a discussion on the soil management practices being demonstrated whether it was reduced tillage, rotation or use of cover crops. The field tour generated good discussions among growers who are interested in improving their soil quality by implementing the different soil management practices being evaluated.

Soil samples were collected from demonstration sites established in the fields of four collaborating growers. The number of sites sampled is down from 2003 and 2004 due to unforeseeable changes in grower practices as a result of environmental (weather) and equipment constraints. With the help of the extension educators, several new demonstration sites were established in 2005 and will continue to be followed for the duration of the project and possibly afterward. From these demonstration sites we have learned of the impact of individual or multiple practices on soil health and productivity of individual sites.

As part of the outreach efforts of this project, our team has provided progress reports to our collaborating growers. Each report highlighted the results of the soil physical, chemical and biological measurements used to assess the soils collected from each site and was accompanied with an explanation of their results. Frequency distributions for the various parameters were provided so growers could relate their results to those of other collaborating growers and fields sampled throughout the state.

Soil health measurements have also continued at our replicated long-term, research sites which include the more recently established Gates Farm in Geneva, NY and the Organic Research Farm in Freeville, NY as well as the four long-term and replicated research experiments in Northern New York (Chazy and Willsboro) and in Central NY (Aurora). Since establishment of the long-term soil health research site at Gates Farm in 2003, we have demonstrated that the suppressive capacity of the soil can be improved within one season with the implementation of reduced tillage (strip-till or no-till). Soil microorganisms are able to respond to environmental

changes more rapidly; multiplying under favorable conditions or dying or becoming quiescent under adverse conditions. In general, the planting of a fall cover crop in 2003 increased the free-living nematode population, increased microbial activity as indicated by the decomposition rate of a cellulose filter paper, and in the case of vetch, increased the potentially mineralizable nitrogen (PMN) rate. This was irrespective of the tillage treatment indicating that the cover crop did not need to be turned under in order to benefit the soil microbial community. Various soil physical parameters such as bulk density, total porosity and volumetric moisture content were also affected by use of a cover crop but not by changes in tillage practices. These practices are also being related to crop growth, yield and farm profitability. At the Gates Farm site, the type of tillage (conventional, strip-till/ deep ripping, or no-till) did not effect the growth and yield of field corn in 2004, but yields were highest in plots with a vetch cover crop and lowest in the plots without a cover crop in fall 2003. However, in 2005 the sweet corn crop had a significantly higher yield in the not-till and strip-till plots than in the conventionally plowed plots. Yield of table beets was highest on raised ridges and after a vetch cover crop.

- **Soil Health Measurement Protocols and Indicator Soil Properties (Milestone 5):** The soil sampling protocol has been streamlined from the collection of two soil samples, one pre-till for analysis of physical indicators and one post-till/pre-plant for analysis of chemical and biological indicators, to one sample collected pre-plant. This new sampling strategy will increase sampling efficiency for those taking as well as processing the samples. During 2005, we studied the variability and consistency of different soil physical indicator properties over time and in different soil types. The aggregate stability test using 0.25-2.0 mm sized aggregates showed treatment differences most consistently and significantly. Values were higher by 16 to 40% in no-till than in conventional-till systems, and higher by 5 to 32% in maize-after-grass than in continuous maize rotations. Bulk density, available water capacity and pores above field capacity were also found to be useful indicators depending on soil type and/or soil management practices. The usefulness of decomposition rates and potential mineralizable nitrogen (PMN) were critically assessed during 2005. The decomposition rate measured total biological activity at sampling and was straightforward to conduct, but it should be coupled with other biological measurements when interpreted. PMN was a useful indicator of available nitrogen and also a good measure of microbial activity. Root health appears to be sensitive and highly effective in determining the potential for the development of root diseases. The population and diversity of nematode is related to the percent soil organic matter, total biological activity and the type of production system. However, it is variable by the time of sampling and soil type as well as costly to assess therefore, it will not be included in the minimum data set for soil health assessment, but can be used as an additional tool for making management decisions. Our laboratories have also begun to work on the use of active carbon and determining the weed seed bank as possible additional indicators of soil health.

Based on the results from our sampling efforts, we have identified six indicators for routine use in assessing the health of vegetable soils in NY State. The selected indicators are root health based on a soil bioassay with bean, potential mineralizable nitrogen (PMN), soil organic matter, pH, soil aggregate stability and soil bulk density. These soil indicators have shown adequate sensitivity to changes in soil management practices from our data sets and will be offered on fee for service basis in 2006.

- **Soil Health Website (<http://www.hort.cornell.edu/soilhealth/>) (Milestone 6):** The Cornell soil health website, which was established in 2003, continues to be an important source of information of soil health and soil health related issues. The soil health related presentations

from the NY Fruit and Vegetable Expo in Syracuse, NY were made available as was an updated list of soil health related field days and events held across the state. To further unify and standardize the procedure for soil sampling among the extension educators and interdisciplinary staff and faculty, the soil sampling protocols were made accessible via the website. Soil health results will be expanded and images illustrating the health status of New York soils will be added soon.

- **Implementation of Promoted Soil Health Practices by Growers (Milestone 7):** Growers have been implementing various soil management practices on their farms. The implementation of these practices will be documented by means of a follow-up survey. The survey currently being prepared will enable us to ascertain changes in growers' knowledge of soil health issues and their adoption of various soil management practices promoted by the efforts of our program work team.

Outcomes for 2005 as they relate to the Performance Targets: In 2005, we analyzed over 300 soil samples using various physical, chemical and biological soil health indicators. The increase in sample numbers this year was due to the expansion in the number of growers who are interested in assessing the health of their field soils. Soil assessment results from these soils under various soil management practices (tillage, cover crops, rotations, etc.) were shared with various stakeholder groups (growers, researchers, extension educators, and crop consultants, etc.) during our summer and fall field days, meetings and workshops. A major source of excitement among the different stakeholder groups was the streamlining of the soil health assessment indicators down to select a few rapid, economic and meaningful soil properties (establishment of the minimum data set for baseline assessment of soil health). We are currently discussing with the Cornell Nutrient Analysis Laboratory (CNAL) on how to offer the chosen soil indicators on a fee-for-service basis, which we hope will become available in 2006.